(19) EuropäischesPatentamt
EuropeanPatentOffice
Officeeuropéendesbrevets

(11) EP 1022936 B1

(12) **EUROPEANPATENTSPECIFICATION**

(45) Dateofpublicationandmention ofthegrantofthepatent:
16.06.2004 Bulletin 2004/25

(21) Applicationnumber: **98949214.5**

(22) Dateoffiling: **08.10.1998**

(51) IntCl. 7: **A01G 25/02**

(86) Internationalapplicationnumber:
PCT/IL1998/000488

(87) Internationalpublicationnumber:
WO 1999/018771(22.04.1999 Gazette 1999/16)

(54) **ANIMPROVEDIRRIGATIONEMITTERUNIT**

VERBESSERTERTROPFBEWÄ SSERUNGSAUSLASS

UNITEEMETTRICED'IRRIGATIONAMELIOREE

(84) DesignatedContractingStates:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MCNLPTSE

(30) Priority: **14.10.1997 IL 12196797**

(43) Dateofpublicationofapplication:
02.08.2000 Bulletin 2000/31

(60) Divisionalapplication:
04007191.2

(73) Proprietor: **HYDROPLANENGINEERINGLTD.**
Tel-Aviv61581(IL)

(72) Inventor: **MEHOUDAR,Raphael**
69494TelAviv(IL)

(74) Representative: **Goetz,Rupert,Dipl.-Ing.**
Wuesthoff&Wuesthoff
Patent-undRechtsanwälte
Schweigerstrasse2
81541München(DE)

(56) Referencescited:
EP-A-0659334
FR-A-2366790
FR-A-2468810
GB-A-2043417
US-A-4210287
US-A-4392616

EP 1 022 936 B1

Description

FIELDOFTHEINVENTION

[0001] This invention relates to an improved irrigation emitter unit for use in a drip irrigation system. The invention is specifically applicable to such systems wherein the emitter units are integrally bonded at spaced-apart intervals to the inner surface of a conduit adjacent to outlet apertures in the conduit, so that an irrigation flow through the conduit results in a drip rate irrigation output fromtheindividualemitterunitsviatheoutlets.

BACKGROUNDOFTHEINVENTION

[0002] Such drip irrigation systems and, in particular, emitter units for use therewith, have been known for some time. They involve the provision in the emitter of an elongated, flow-restricting flowpath through which water passes from the conduit so as to emerge from the conduitoutletasasubstantiallypressurelessdrip.

[0003] The construction and provision of this flow-restricting flowpath has in general fallen into two main categories,namely:

a) where the flowpath is entirely defined within an emitterhousing;and

b) where the flowpath is defined between the emitter housing and the surface of the conduit to which thehousingisbonded.

[0004] The present invention is specifically related to the first of these categories, i.e. where the flowpath is defined within the housing. Furthermore, the invention preferably relates to such an emitter unit which is provided with flow control means, e.g., differential pressure control means, designed to ensure that the output rate from the emitter is substantially independent of variations in the pressure of the irrigation supply flow to the emitterunit.

[0005] Such a drip irrigation system and, in particular, irrigation emitter units for use therewith, have been disclosed in our earlier U.S. Patent No. 4,210,287 (hereinafter "the '287 patent"). The '287 patent discloses an emitter unit provided with a resiliently flexible membrane which is releasably retained within an elongated body or housing member so as to serve a double function, namely, an the one hand, whilst being exposed to the irrigation flow pressure in the conduit to serve in exercising differential pressure control, and, on the other hand, to define, with respect to a flow restricting groove formed in the body member with a pair of oppositely directed sets of flow resisting triangular baffles, a flow-restricting elongated flowpath between a housing inlet and ahousingoutlet.

[0006] There have also been previous proposals for enclosing the emitter unit in a housing. These proposals have not included adequate solutions, if at all, in connection with problems which arise regarding the possible assembly of the constituent elements of an elongatedhousing.

[0007] From US patent specification 4,105,162 corresponding to French patent specification 2 366 790 an emitter is known comprising a flow-retarding member made of resilient material disposed in a flat disc-shaped circular housing constituted by two members, a cup-shaped base member and a closure cap releasably attached thereto by a snap-fit between an annular recess in the cap and a snap-fit shoulder of the base member. The flow-retarding member is formed with a circuitous fluid flowpath defined at least in part by recesses formed in both opposing faces that vary with the inlet pressure. A flat regulator member is disposed between the flow-retarding member and the housing inlet such that the inlet face of the regulator member is subjected to the fluid pressure at the inlet of the housing. The cup-shaped housing member has a central stem with a central inlet bore and shoulder engageable with the inner surface of a water conduit or fluid-carrying pipe at a positionwhereitisprovidedwithanoutletopening.

[0008] Another conventional drip irrigation emitter with an elongated housing adapted to be attached by plastic-welding to an inner surface of a water supply pipe beneath a water discharge opening is described in US patent specification 5,294,058. Flow control is achieved with an elastomeric membrane with a flow restrictor orifice centrally through a thin wall section of it. The housing is formed of two rectangular snap-fit housing sections and the membrane interposed between the sections, the cup-shaped receiving section having formed therein a recessed peripherally-extending ledge for engagement with an inserted cover section. No flow-restricting elongated flowpath is defined entirely within the emitter housing. This emitter does not belong to the above-mentionedfirstcategory.

[0009] Particular problems clearly arise where, as in the case of emitter units the subject of the present invention, relatively long, elongated emitter units are required and means have to be provided for the retention together of the constituent pieces of the housing prior to its bonding to the conduit, especially when the housing is formed of relatively pliable plastic material (e.g. polyethylene) so as to facilitate its ready bonding to the conduit.

[0010] It is therefore an object of the present invention to provide a new and improved irrigation emitter unit for use in drip irrigation systems, wherein the above-referred-torequirementissubstantiallyachieved.

BRIEFSUMMARYOFTHEINVENTION

[0011] According to the present invention, there is provided an emitter unit adapted to be integrally bonded to an internal surface of a conduit, comprising an elongated housing, a housing inlet adapted to communicate with an interior of said conduit; a housing outlet adapted

to communicate with a conduit outlet; an elongated, flow-restricting flowpath formed in said housing; a flowpath inlet communicating with said housing inlet; a flowpath outlet communicating with said housing outlets; a resiliently flexible membrane mounted in said housing; said housing being of closed box-like shape and being constituted by an elongated receiving member and a correspondingly elongated cover member; and projection and recess interengaging means formed along the lengths of elongated rim portions of said members and directed substantially transversely to longitudinal axes of said members such that projection means of one member are adapted to form a close pressure fit within correspondingrecessmeansoftheothermember.

[0012] The pressure fitting together of interengaging means located along the lengths of the rims of the constituent members of the housing ensures effective retention together of these members after their assembly together and effectively prevents their coming apart prior to the bonding of the housing to the conduit. This is of particular importance seeing that, an the one hand, the emitter units have to be stored after assembly and consequently subjected to mechanical handling during the bonding procedure and, an the other hand, the enclosed membrane has to be retained in the housing underacertaindegreeofresilientpressure.

[0013] By virtue of the possibility to provide relatively elongated emitter units of secure, box-like construction in accordance with the present invention, it is possible to achieve certain further additional advantages, among whichmaybementioned

(i) the provision of a plurality of superimposed interconnecting flow restricting flowpaths respectively separated by the membrane or additional membranes;

(ii) the incorporation in the emitter unit of an effectivenon-returnvalvestructure;and

(iii) the provision of extended filtering arrangements.

[0014] Preferably, the emitter unit is provided with differential pressure control means, in which case there is formed in the housing a recess having dimensions substantially extended as compared with the width of the flowpath, with a recess outlet formed in a base of the recess, a rim of the recess having an area substantially greater than the area of the recess outlet, a first surface of the membrane adapted to be exposed to fluid inflow pressure; a second and opposite surface of said membrane being juxtaposed to said rim and adapted to be pressed against said rim under said inflow pressure; and so as to define with said recess an outlet control chamber; the arrangement being such that when said fluid inflow pressure exceeds the fluid pressure in said outlet control chamber by a predetermined amount, the membrane flexes towards said recess outlet so as to define withtherecessoutletarestrictedoutflowpath.

[0015] Thus, there are preferably formed during the relatively simple molding of the constituent members of the housing, appropriate flow-restricting elongated grooves together with the outlet control chamber recess, these grooves and recess, together with the interposed membrane, defining the flow-restricting flowpaths and theoutletcontrolchamber.

[0016] By virtue of the provision of the box-like housing, it is possible to provide, in the housing, in accordance with one aspect of the present invention, one or more elongated inflow channels located preferably adjacent one or both elongated edges of one of the constituent members of the housing. These channels communicate with the housing inlet and are exposed to the interioroftheconduit.

[0017] These channels, which are also formed during the molding of one or other of the constituent members of the housing, are partially covered, thus facilitating the provision of a relatively restricted filtering type inlet into the channels and at the same time allowing for the provisionofrelativelywidelydimensionedchannels.

[0018] The channels are provided with an array of filter baffles located along the length thereof. In this way, irrigation flow passes into the emitter unit, along one or more extended, open inflow channels provided with filtering means, and in this way the inflow channel itself can be of relatively wide dimensions, thereby again restrictingthedangersofblockage.

BRIEFDESCRIPTIONOFTHEDRAWINGS

[0019] For a better understanding of the present invention and to show how the same may be carried out in practice, reference will now be made to the accompanyingdrawings,inwhich

Fig. 1 is an exploded, perspective view of one embodiment of an emitter unit in accordance with the presentinvention;

Fig. 2 is an exploded, perspective view of the emitter unit in accordance with the present invention, shown in an inverted sense with respect to the view showninFig.1;

Fig. 3 is a perspective view of the assembled emitterunitinaccordancewiththepresentinvention;

Fig. 4 is a perspective view (inverted with respect to the view shown in Fig. 3) of the emitter unit in accordance with the invention, shown partially cut away;

Fig. 5 is a longitudinally-sectioned view of a drip irrigation system incorporating the emitter unit in accordance with the present invention, in an initial stageofoperation;

Fig. 6 is a longitudinally-sectioned view of a drip irrigation system incorporating the emitter unit in accordance with the present invention, in a subsequentstageofoperation;and

Fig. 7 is a cross-sectional view of the drip irrigation

system shown in Fig. 5, taken along the line VII-VII.

DETAILEDDESCRIPTIONOFAPREFERRED EMBODIMENT

[0020] As seen in the drawings, the emitter unit in accordance with the invention comprises an elongated housing 1 (see Fig. 3) which is essentially of box-like, rectangular shape having rounded ends. The housing 1 is constituted by a correspondingly shaped elongated receiving member 2, a correspondingly shaped elongated cover member 3 and a correspondingly shaped elongated,resilientlyflexiblemembrane4.

[0021] As seen in Figs. 1 and 2 of the drawings, the receiving member 2 essentially consists of a substantiallyplanarbasewall6andaperipheralsidewall7.

[0022] The peripheral side wall 7 is formed with a pair of rectilinear, elongated side rim portions 8a and a pair ofcurvedendrimportions8bwithfrontsurface80'.

[0023] Formed in each elongated side rim portion 8a is an array of alternating dovetailed shaped recesses 9a and projections 9b with side surfaces 82' with interacting walls 84' directed along the side surfaces 82' and terminating at the front surface 80'. The projections 9b are themselves recessed, thereby imparting resilient flexibilitytothedefiningwallsoftheprojections9b.

[0024] Formed in the inner surface of the base wall 6 of the receiving member 2 is an elongated groove 11 which extends from an inlet end portion 11a (of relatively extended width) to an interim terminal portion 11b via a flow-restricting portion 11c formed in a known manner with a pair of oppositely directed sets of flow-restricting, substantiallytriangularbaffles12.

[0025] An inlet well 13 is formed in the inlet portion 11a, defined by a tapering wall portion 14 having a peripheral well rim 16. This rim 16, as seen clearly in Figs. 5 and 6 of the drawings, extends from the inner surface ofthebasewall6beyondthebaffles12.

[0026] Referring now to Figs. 2, 4 and 7 of the drawings, there are formed in an outer surface of the base wall 6 of the receiving member 2, respectively adjacent the elongated edges thereof, a pair of elongated inflow channels 17a and 17b, having respective arrays of filter baffles 18a and 18b located along the lengths thereof. Formed in the base wall 6 of the receiving member 2 is a transversely directed coupling channel 19 which serves to effect communication between the elongated inflow channels 17a and 17b. The coupling channel 19 communicates via a central aperture 19a with the well 13. Thus, the elongated inflow channels 17a and 17b all debouch via the coupling channel 19 into the central aperture 19a and therefore constitute the sole source of inflowintotheemitterunit.Atransverselydirectednarrow molding slot 21 is formed in the upper surface of the base wall 6 of the receiving member 2 and communicatesalongitslengthwiththecouplingchannel19.

[0027] As can be seen, particularly in Figs. 4 and 7 of the drawings, the elongated inflow channels 17a and 17b (which are formed during the molding of the receiving member 2) are formed with a partial covering 17c. In this way there are facilitated the provision of a relatively restricted filtering type inlet into the channels 17a, 17b and, at the same time, allowing for the provision of relativelywidelydimensionedchannels17a,17b.

[0028] The cover member 3 is formed with elongated rectilinear side rim portions 22a and curved end rim portions22bwithfrontsurface80".

[0029] Formed along the length of each elongated side rim portion 22a is an array of alternating projections 23a with side surfaces 82 and recesses 23b with interacting walls 84 directed along the side surfaces 82" and terminating at the front surface 80" of dovetailed cross-sectional shape. Each recess 23b has formed, projectingfromitsbase,asemi-cylindricalstud23c.

[0030] The projections and recesses 23a and 23b correspond in shape and dimensions with the recesses and projections 9a and 9b so that the projections 23a, 9b are capable of being press fitted and firmly retained within therecesses23b,9a.

[0031] The provision of the recessed projection 9b on either side of the defining walls of the recess 9a allows for relative flexibility of these walls upon insertion of the projections 23a therein. The studs 23c effectively fit the recessesformedintheprojections9b.

[0032] Formed on an inner surface of the cover member 3 is an elongated groove 24 corresponding in shape and dimensions with the groove 11. In this case, the groove is formed with a downstream terminal portion of extended dimensions and constituting a recess 24a which corresponds in size and dimensions with the inlet portion 11a formed in the receiving member 2. The groove 24 is furthermore formed with an interim inlet portion 24b corresponding in shape and dimensions with the interim terminal portion 11b of the groove formed in the receiving member 2. Finally, the groove 24 comprises an elongated, flow-restricting portion 24c corresponding in shape and dimensions with the flow-restricting groove portion 11c formed in the receiving member 2 and, like that flow-restricting groove portion, is formed with flow-restricting baffles 25. Formed in the base of the recess 24a is a recess outlet 26 which extends through the cover member 3. A narrow blind groove 27 is formed in the base wall of the recess 24a andcommunicateswiththerecessoutlet26.

[0033] The elongated, resiliently flexible membrane 4 corresponds in size and dimensions with the inner surface of the receiving member 2 and is formed with a communicating aperture 28 designed, in the assembled emitter unit, as clearly seen in Figs. 5, 6 and 7 of the drawings, to be located between the interim terminal portion 11b of the groove 11 and the interim inlet portion 24bofthegroove24inthecovermember3.

[0034] Assembly of the emitter unit 1 is effected by inserting the membrane 4 into the receiving member 2 and by press fitting the cover member 3 into the receiving member 2, whereby the projections 23a and 9b are

firmly and frictionally fitted and retained within the recesses9aand23b.

[0035] As can be seen in Fig. 6 of the drawings, when assembled, the membrane 4 is biasingly pressed against the peripheral well rim 16, thereby effectively sealing the emitter unit against return flow or leakage from the outlet 26 to the inlet of the emitter. In this way, the emitter is formed with an effective non-return valve structure. Opening of the valve so as to allow for flow of water into the emitter via the inlets 19, 19a is only possible when the inflow pressure is sufficient to displace themembrane4awayfromthewellrim16.

[0036] The thus assembled emitter unit 1 can thereafter be stored for subsequent insertion and bonding to a conduit during the extrusion thereof, for example in accordance with the process as described and illustratedinourearlierU.S.PatentNo.5,324,371.

[0037] The means employed to secure the cover member 3 within the receiving member 2, whereby the extended surfaces of the projections 23a, 9b ensure that the recesses 9a, 23b are in pressed frictional contact, rendering the disassembly of the units during storage, and during the insertion and bonding process, extremely unlikely.

[0038] It will be noted that in the preferred embodiment just described, each projection interengaging means 23a, 9b is at its narrowest adjacent the rim portion 22a, 8a of the members 3, 2 from which they respectively extend and widens out towards the rim portions 8a, 22a of the other members 2, 3 whilst each recess interengaging means 9a, 23b is at its widest adjacent the rim portion 8a, 22a of the members 2, 3 in which they are formed and narrows down towards the rim portion 22a, 8a of the other member 3, 2. By virtue of this construction, and the fact that both the projections and the recesses extend normally to the longitudinal axes of the members 2 and 3, the members are effectively secured against possible separating forces directed transversely to the longitudinal axes. Furthermore, the extended surfaces of the projections, on the one hand, and the recesses, on the other hand, ensures effective frictional retention of the projections within the recesses against outward displacement of the members 2, 3 with respecttoeachother.

[0039] Whilst in the specific example illustrated and described the projections 23a and recesses 9a are shown as being essentially dovetailed in shape, other essentially equivalent shapes can also be utilized. Thus, for example, Ω-shaped projections and recesses can be employed.

[0040] Furthermore, adequate retention can in. some instances be ensured with a single pair of interengaging projections and recesses, as well as with such projections and recesses of essentially parallel-walled construction.

[0041] As seen in Figs. 5, 6 and 7 of the drawings, the emitter unit 1 is bonded to the inner surface of a conduit 30 precisely at the inter-engaged rim portions 8 and 22 of the receiving and cover members 2 and 3, and this act of bonding permanently secures the members 2 and 3 together and ensures their sealing attachment to each otherandtotheconduit30.

[0042] Reference will now be made to Figs. 4, 5, 6 and 7 of the drawings for an explanation of the mode of operation of a drip irrigation system incorporating the emitterunit1justdescribedandillustrated.

[0043] Irrigation water flowing through the conduit 30 passes through the filtering inflow channels 17a and 17b and the molding slot 21 and via the coupling channel 19 and central aperture 19a into the well 13. The pressure of the inflowing water displaces the membrane 4 from its biased, sealing position on the peripheral well rim 16 (as seen in Figs. 4 and 6), allowing for the flow of water in the direction of the arrows shown in Fig. 6 through a flow-restricting flowpath defined between the membrane 4 and the flow-restricting groove 11c into the interim terminal groove portion 11b. The water then passes via the communicating aperture 28 into the inlet groove portion 24b, through the elongated, flow-restricting flowpath defined between the membrane 4 and the grooveportion24c,andintotherecess24a.

[0044] Water emerges from the recess 24a via the recess outlet 26, having undergone extended flow-rate restriction in the flow-resisting flowpath, so as to emerge asapressurelessdrip.

[0045] The membrane 4, which bears on the rim of the recess 24a, defines with the recess 24a an effective outlet control chamber with one surface of the membrane 4 being exposed to the inlet flow pressure, and the opposite surface of the membrane 4 being exposed totheflowpressureintheoutletcontrolchamber.

[0046] Thus, there is effected differential pressure control whereby, when the fluid inflow pressure exerted on said first surface of the membrane 4 exceeds the fluid pressure in the outlet control chamber by a predetermined amount, the membrane 4 flexes towards the recess outlet 26 so as to define with a recess outlet a restricted outflow path. Such differential pressure control, as applied to irrigation emitter units, has been previously described,e.g.inthe'287Patent.

[0047] It will be understood that with emitter units in accordance with the present invention, the use of the box-like housing allows for the provision of the double-layered and therefore particularly elongated, flow-restricting flowpaths. Such long, flow-restricting flowpaths have width dimensions which are significantly greater than those which could be employed with emitter units of conventional construction, and this, of course, is of considerable importance in minimizing the dangers of blockageoftheflowpathsbygrit,orthelike.

[0048] It will be appreciated, however, that the invention is equally applicable to emitter units having only a single flow-restricting layer. Similarly, the invention is equally applicable to emitter units wherein the, or each, flow-restricting layer has more than one flow-restricting flowpath.

[0049] Whilst the invention has been specifically described with reference to the use of the membrane so as to achieve differential pressure control, it will be understood that the invention is equally applicable to emitter units employing differing forms of flow control and wherein the membrane serves to define with the internal housing walls the flow restricting flowpath and also to interact therewith so as to provide effective flow control.

[0050] Furthermore, whilst the application of the invention has been specifically described in the context of the bonding of the emitter units to an extruded conduit during the extrusion process, the invention is equally applicable to the bonding of the emitter units in accordance with the invention to an inner surface of a conduit strip blank which is then subsequently welded at its longitudinaledgessoastoformtheconduit.

[0051] Furthermore, the utilization of the relatively substantial wall of the receiving member 2 for the provision of filtering inflow channels again allows for the use of inflow paths which are relatively larger in width than those of conventional emitter units, here again minimizingthedangersofblockage.

[0052] This is of particular significance where, as in the emitter unit specifically described and illustrated, a non-return valve construction is provided for. With such a construction, only a single restricted inlet 19,19a into the emitter unit is available, and such a restricted inlet could not accommodate adequate filtering means. Such means are therefore provided for by means of the filtering inflow channels rendered possible by the construction of the emitter unit in accordance with the invention.

Claims

1. Emitter unit adapted to be integrally bonded to an internal surface of a conduit (30), comprising an elongated housing (1), a housing inlet (13) adapted to. communicate with an interior of said conduit; a housing outlet (26) adapted to communicate with a conduit outlet; an elongated, flow-restricting flowpath (11c, 24c) formed in said housing; a flowpath inlet (11a) communicating with said housing inlet (13); a flowpath outlet (24a) communicating with said housing outlet (26) ; a resiliently flexible membrane (4) mounted in said housing; said housing (1) being of closed box-like shape and constituted by an assembly of a receiving member (2) and a cover member (3); said receiving and cover members (2, 3) each having a rim portion (8a, 22b) with a front surface (80', 80") and side surfaces (82', 82"), the front surfaces (80', 80") of the receiving and cover members (2, 3) facing each other prior to their assembly, said receiving and cover members (2, 3) having projection and recess interengaging means (9b, 9a, 23a, 23b) formed in the rim portions (8a, 22b) of said members (2, 3), said projection and recess means having interacting walls (84', 84") directed along said side surfaces (82', 82") and terminating at said front surfaces (80', 80"), such that projection interengaging means (9b, 23a) of the one member are adapted to form a close pressure fit within corresponding recess interengaging means (9a,23b)oftheothermember.

2. Emitter unit according to claim. 1, wherein said receiving and cover members (2, 3) are provided with a plurality of said projection and recess interengagingmeans(9b,9a,23a,23b).

3. Emitter unit according to claim 2, wherein successive projection and recess interengaging means (9b,9a,23a,23b)arearrangedinarrays.

4. Emitter unit according to any one of claims 1 to 3, wherein the or each projection interengaging means (9b, 23a) is at its narrowest adjacent the rim portion (8a, 22a) of the member (2, 3) from which it extends and widens out towards the rim portion (8a, 22a) of the other member (3, 2) whilst the or each recess interengaging means (9a, 23b) is at its widest adjacent the rim portion (8a, 22a) of the member (2, 3) in which it is formed and narrows down towards the rim portion (8a, 22a) of the other member (3,2)

5. Emitter unit according to claim 4, wherein each recess interengaging means (9a, 23b) has formed adjacent thereto a recessed, resilient projection interengagingmeans(9b,23a).

6. Emitter unit according to claim 3, wherein said projection interengaging means (9b, 23a) and corresponding recess interengaging means (9a, 23b) are ofsubstantiallydovetailedshape.

7. Emitter unit according to any one of claims 1 to 6, wherein there is formed in said housing (1) a recess (24a) having a recess outlet (26) formed in a recess base, said recess (24a) having a recess inlet of an area substantially greater than the area of said recess outlet (26) and being of extended dimensions as compared with the width of the flowpath (24c) between the recess inlet and the recess outlet; a first surface of the membrane (4) adapted to be exposed to fluid inflow pressure; a second and opposite surface of said membrane being juxtaposed to said rim portions (22a, 22b) so as to be pressed against said rim portions under said inflow pressure and so as to define with said recess (24a) an outlet control chamber; the arrangement being such that when said fluid inflow pressure exceeds the fluid pressure in said outlet control chamber by a predetermined amount, the membrane (4) flexes towards said recess outlet (26) so as to define with the recessoutletarestrictedoutflowpath.

8. Emitter unit according to any one of claims 1 to 7 wherein there is formed in an inner surface of at least one of said members (2, 3) an elongated groove (11, 24) which together with the membrane (4) defines said flow restricting flowpath (11c, 24c).

9. Emitter unit according to claim 8, wherein there are formed in the inner surfaces of both said members (2, 3) elongated grooves (11, 24) which together with said membrane (4) respectively define component flow restricting flowpaths (11c, 24c) which communicate via a communicating aperture (28) formedinsaidmembrane(4).

10. Emitter unit according to claim 8 or 9, wherein each groove (11, 24) is formed with a pair of oppositely directedarraysofflowrestrictingbaffles(25).

11. Emitter unit according to claim 9 or 10 when appendent on claim 7, wherein said flowpath inlet (11a) is associated with a first (11) of said grooves (11, 24), said flowpath outlet is associated with a second (24) of said grooves (11, 24), said housing inlet (13) is formed in a first (2) of said members (2, 3), said housing outlet (26) and said recess (24a) are formed in a second (3) of said members (2, 3), and said communicating aperture (28) is formed in said membrane (4) adjacent to a downstream end of said first groove (11) and an upstream end of said secondgroove(24).

12. Emitter unit according to any one of claims 1 to 11, wherein said housing inlet includes an inlet well (13) projecting into said housing (1) and having a peripheral well rim (16) against which said membrane (4) is normally sealingly biased, the arrangement being such that a predetermined minimum fluid inflow pressure bearing an said membrane (4) is effective in displacing the membrane from its sealing engagementwiththewellrim(16).

13. Emitter unit according to any one of claims 1 to 12, wherein there is formed adjacent at least one elongated edge of one of said members (2) in an outer surface thereof an elongated inflow channel (17a, 17b) communicating with said housing inlet (13), adapted to be exposed to the interior of the conduit (30) and having an array of filter baffles (18a, 18b) locatedalongthelengththereof.

14. Emitter unit according to claim 13, wherein a pair of said elongated inflow channels (17a, 17b) are respectively formed adjacent the opposite elongated edgesofsaidonemember(2).

15. Emitter unit according to claim 13 or 14, wherein the or each elongated inflow channel (17a, 17b) is formed in the outer surface of the receiving member (2).

16. Emitter unit according to claim 13, 14 or 15 when appendent on claim 1, wherein said inflow channels (17a,17b)alldebouchintosaidhousinginlet(13).

17. Emitter unit according to any one of claim 13 to 16, wherein said inflow channels (17a, 17b) are partially covered.

18. Drip irrigation system comprising an irrigation conduit (30) and a succession of spaced apart emitter units (1) according to any one of the preceding claims bonded to an inner surface of said conduit (30) at the interengaging rim portions of said members(2,3).

19. Emitter unit according to claim 1, wherein said membrane (4) is mounted in said housing (1) so as to overlie and interengage with at least a portion of saidflowpath(11c,24c).

20. Emitter unit according to claim 19, wherein said housing inlet includes an inlet well (13) projecting into said housing and having a peripheral well rim (16) against which said membrane (4) is juxtaposed.

21. Emitter unit according to claim 20, wherein said membrane (4) is normally sealingly biased against the peripheral well rim (16), the arrangement being such that a predetermined minimum fluid inflow pressure bearing an said membrane is effective in displacing the membrane from its sealing engagementwiththewellrim.

22. Emitter unit according to claim 1, wherein said membrane(4)isadaptedtorestrictoutflow.

23. Emitter unit according to claim 1, wherein said walls (84', 84") interact when said housing (1) is assembled.

24. Emitter unit according to claim 1, wherein said walls (84', 84") are directed transversely to the longitudinal axes as seen in a direction of the assembly of saidmembers(2,3).

Patentansprüche

1. Emittereinheit, die zur integralen Verbindung mit der inneren Oberfläche einer Leitung (30) geeignet ist, mit einem länglichen Gehäuse (1), einem Gehäuseeinlass (13), durch den eine Verbindung zum Innenraum der Leitung hergestellt wird, einem Gehäuseauslass (26), der mit einem Auslass der Leitung in Durchlassverbindung gebracht werden

kann, einem im Gehäuse ausgebildeten länglichen strömungshemmenden Strömungsweg (11c, 24c), einem Einlass (11a) für einen Strömungsweg, der mit dem Gehäuseeinlass (13) in Verbindung steht, einem Auslass (24a) für den Strömungsweg, der mit dem Gehäuseauslass (26) in Verbindung steht, einer in dem Gehäuse angebrachten nachgiebigen flexiblen Membran (4), wobei das Gehäuse (1) von geschlossener kastenförmiger Gestalt ist und aus der Verbindung eines Aufnahmeteils (2) und eines Abdeckteils (3) hervorgegangen ist, wobei das Aufnahmeteil und das Abdeckteil (2, 3) jeweils einen Randbereich (8a, 22b) mit einer Vorderfläche (80', 80") und mit Seitenflächen (82',82") haben, von denen die Vorderflächen (80', 80") des Aufnahmeteils (2) und des Abdeckteils (3) vor dem Zusammenbau einander zugewandt sind, wobei das Aufnahmeteil (2) und das Abdeckteil (3) miteinander in Eingriff kommende vorspringende und zurückspringende Verbindungsteile (9b, 9a, 23a, 23b) an den Randbereichen (8a, 22b) der Aufnahme- und Abdeckteile (2, 3) haben, wobei die vorspringenden und zurückspringenden Verbindungsteile miteinander zusammenwirkende, zu den Seitenflächen (82', 82") ausgerichtete und an den Vorderflächen (80', 80") endende Flächen (84', 84") haben, derart, dass vorspringende Verbindungsteile (9b, 23a) des einen Teils so ausgebildet sind, dass sie einen dichtschließenden Druckverschluss innerhalb des korrespondierenden zurückspringenden Verbindungsteils(9a,23b)desanderenTeilsbilden.

2. Emittereinheit nach Anspruch 1, bei der das Aufnahmeteil und das Abdeckteil (2, 3) mit einer Vielzahl von vorspringenden und zurückspringenden Verbindungsteilen (9b, 9a, 23a, 23b) ausgestattet sind.

3. Emittereinheit nach Anspruch 2, bei der aufeinanderfolgende vorspringende und zurückspringende Verbindungsteile (9b, 9a, 23a, 23b) in Reihen angeordnetsind.

4. Emittereinheit nach einem der Ansprüche 1 bis 3, bei der das oder jedes vorspringende Verbindungsteil (9b, 23a) am schmalsten angrenzend an dem Randbereich (8a, 22a) des Verbindungsteils (2, 3) ist, von wo es sich erstreckt und nach außen zum Randbereich (8a, 22a) des anderen Verbindungsteils (3, 2) erweitert, während das oder jedes andere zurückspringende Verbindungsteil (9a, 23b) am weitesten am Randbereich (8a, 22a) des Verbindungsteils (2, 3) ist, in dem es ausgebildet ist und sich zum Randbereich (8a, 22a) des anderen Verbindungsteils(3,2)hinverjüngt.

5. Emittereinheit nach Anspruch 4, bei dem jedes zurückspringende Verbindungsteil (9a, 23b) daran anschließen ein Zurückspringen des, nachgiebiges vorspringendesVerbindungsteil(9b,23a)hat.

6. Emittereinheit nach Anspruch 3, bei dem die vorspringenden Verbindungsteile (9b, 23a) und die korrespondierenden zurückspringenden Verbindungsteile (9a, 23b) im Wesentlichen einen schwalbenschwanzförmigeFormgebunghaben.

7. Emittereinheit nach einem der Ansprüche 1 bis 6, bei dem innerhalb des Gehäuses (1) eine Aussparung (24a) mit einem im Unterteil der Aussparung ausgebildeten Aussparungsauslass (26) ausgebildet hat, wobei die Aussparung (24a) einen Aussparungseinlass mit einem erheblich größeren Querschnitt als der Querschnitt des Aussparungsauslass (26) hat und eine vergrößerte Abmessung im Vergleich mit der Breite des Strömungsweges (24c) zwischen dem Aussparungseinlass und dem Aussparungsauslass aufweist; wobei eine erste Seite der Membran (4) dem Einströmdruck des Fluids ausgesetzt sein kann; eine zweite und gegenüberliegende Seite der Membran den Randbereichen (22a, 22b) gegenüberliegt sodass sie gegen die Randbereiche durch den Einströmdruck gedrängt wird und so mit der Aussparung (24a) eine Auslasssteuerkammer bildet; wobei die Anordnung derart getroffen ist, dass wenn der Einströmdruck des Fluids den Fluiddruck in der Auslasssteuerkammer um einen vorbestimmten Betrag überschreitet, die Membran (4) sich zum Auslass (26) der Aussparung durchbiegt um so zusammen mit dem Auslass der Aussparung einen strömungshemmenden Strömungswegzubilden.

8. Emittereinheit nach einem der Ansprüche 1 bis 7, bei der auf der Innenfläche wenigstens eines der Gehäuseteile (2, 3) eine längliche Nute (11, 24) ausgebildet ist, welche zusammen mit der Membran (4) den strömungshemmenden Strömungsweg (11c, 24c)bildet.

9. Emittereinheit nach Anspruch 8, bei der auf der Innenseite beider Gehäuseteile (2, 3) längliche Nuten (11, 24) ausgebildet sind, die zusammen mit der Membran (4) einen Teil der strömungshemmenden Strömungswege (11c, 24c) bilden, die über eine Verbindungsöffnung (28) miteinander in Verbindungstehen.

10. Emittereinheit nach Anspruch 8 oder 9, bei der die Nut (11, 24) mit einem Paar entgegengesetzt gerichteten Reihen von strömungshemmenden Querwänden(25)versehensind.

11. Emittereinheit nach Anspruch 9 oder 10, wenn auf Anspruch 7 zurückbezogen, bei der der Einlass (11a) für den Strömungsweg einer ersten Nut (11)

der Nuten (11, 24) zugeordnet ist, wobei der Strömungsauslass einer zweiten Nut (24) der Nuten (11, 24) zugeordnet ist, wobei der Einlass (13) in das Gehäuse im ersten Gehäuseteil (2) der Gehäuseteile (2, 3) ausgebildet ist, und wobei der Auslass (26) des Gehäuses und die Ausnehmung (24a) in einem zweiten Gehäuseteil (3) der Gehäuseteil (2, 3) ausgebildet ist und die Verbindungsöffnung (28) in der Membran (4) neben dem stromabwärts gelegenen Ende der ersten Nut (11) und einem stromaufwärts gelegenen Ende der zweiten Nut (24) ausgebildetist.

12. Emittereinheit nach einem der Ansprüche 1 bis 11, bei der der Gehäuseeinlass eine in das Gehäuse (1) vorspringende Einlassdüse (13) aufweist die einen umlaufenden Düsenrand (16) hat, gegen den die Membran (4) in abdichtender Anlage normalerweise angedrückt ist, wobei die Anordnung derart gewählt ist, dass ein vorbestimmter Mindestdruck für den Fluidzufluss, der auf die Membran (4) wirkt, die Membran aus ihrer Abdichtanlage am Düsenrand(16)abzuhebenvermag.

13. Emittereinheit nach einem der Ansprüche 1 bis 12, bei der an wenigstens einer der Längskanten eines der Gehäuseteile (2) in einer Außenfläche von diesem einen länglichen Zulaufkanal (17a, 17b) ausgebildet aufweist, der mit dem Gehäuseeinlass (13) in Verbindung steht und der so ausgebildet ist, dass der dem Innenraum der Leitung (30) ausgesetzt ist und einer Reihe von Filterquerwänden (18a, 18b) hat,dieinderenLängsrichtungangeordnetsind.

14. Emittereinheit nach Anspruch 13, bei der ein Paar der länglichen Zuströmkanäle (17a, 17b) an den einander gegenüberliegenden Längskanten des einenGehäuseteils(2)jeweilsausgebildetsind.

15. Emittereinheit nach Anspruch 13 oder 14, bei der der oder jeder längliche Zuströmkanal (17a, 17b) an der Außenseite des Aufnahmeteils (2) ausgebildetist.

16. Emittereinheit nach Anspruch 13, 14 oder 15, bei Rückbezug auf Anspruch 1, bei der die Zuströmkanäle (17a, 17b) alle jeweils in den Gehäuseeinlass (13)münden.

17. Emittereinheit nach einem der Ansprüche 13 bis 16, bei dem die Zuströmkanäle (17a, 17b) zum Teil abgedecktsind.

18. Tropfbewässerungssystem mit einer Bewässerungsleitung (30) und einer Folge von beabstandeten Emittereinheiten (1) nach einem der vorhergehenden Ansprüche, die an eine Innenfläche der Leitung 30 jeweils an den miteinander verbundenen Randbereichen der Gehäuseteile (2, 3) angebracht sind.

19. Emittereinheit nach Anspruch 1, bei der die Membran (4) derart in dem Gehäuse (1) angebracht ist, dass sie wenigstens einen Teil des Strömungswegs (11c,24c)überspanntundinWechselwirkungtritt.

20. Emittereinheit nach Anspruch 19, bei der der Gehäuseeinlass eine in das Gehäuse hineinragende Einlassdüse (13) mit einem äußeren Düsenrand (16) umfasst, zu der die Membran (4) gegenüberliegt.

21. Emittereinheit nach Anspruch 20, bei der die Membran (14) normalerweise in abdichtender Anlage am äußeren Düsenrand (16) anliegt, wobei die Anordnung derart gewählt ist, dass ein Druck für eine Mindesteinströmung an Fluid, der auf der Membran lastet, bewirkt, dass die Membran aus der abdichtenden Anlage an dem Düsenrand abgehoben wird.

22. Emittereinheit nach Anspruch 1, bei der die Membran (4) derart ausgebildet ist, dass sie den Ausflusshemmt(begrenzt).

23. Emittereinheit nach Anspruch 1, bei der die Wände (24', 24") miteinander zusammenwirken, wenn das Gehäuse(1)zusammengesetztwird.

24. Emittereinheit nach Anspruch 1, bei der die Wände (84', 84") quer zur Längsachse bei Betrachtung in Richtung des Zusammenbaus der Gehäuseteile (2, 3)gerichtetsind.

Revendications

1. Unité émettrice adaptée à être complètement collée sur une surface intérieure d'un conduit (30), comprenant un boîtier longitudinal (1), une entrée (13) de boîtier adaptée à communiquer avec un intérieur dudit conduit ; une sortie (26) de boîtier adaptée à communiquer avec une sortie de conduit ; une voie d'écoulement longitudinale (11c, 24c) restreignant la voie d'écoulement constituée dans ledit boîtier ; une entrée (11a) de voie d'écoulement communiquant avec ladite entrée (13) de boîtier ; une sortie (24a) de voie d'écoulement communiquant avec ladite sortie (26) de boîtier ; une membrane souple avec résilience (4) montée dans ledit boîtier ; ledit boîtier (1) ayant une forme du type d'une boîte fermée et constitué par un assemblage d'un élément de réception (2) et d'un élément de couvercle (3) ; lesdits éléments de réception et de couvercle (2, 3) comportant chacun une partie de rebord (8a, 22a) avec une surface frontale (80', 80") et des surfaces latérales (82', 82"), les surfaces frontales (80', 80")

des éléments de réception et de couvercle (2, 3) faisant face l'une à l'autre avant leur assemblage, lesdits éléments de réception et de couvercle (2, 3) comportant des moyens d'accouplement mutuel de saillies et d'évidements (9b, 9a, 23a, 23b) constituées dans les parties de rebord (8a, 22a) desdits éléments (2, 3), lesdits moyens d'accouplement mutuel de saillies et d'évidements comportant des parois (84', 84") en interaction orientées selon lesdites surfaces latérales (82', 82") et se terminant auxdites surfaces frontales (80', 80"), de manière à ce que les moyens d'accouplement mutuel de saillies (9b, 23a) de l'un des éléments s'adaptent pour constituer une adaptation sous pression avec les moyens d'accouplement mutuel d'évidements correspondants(9a,23b)del'autreélément.

2. Unitéémettriceselonlarevendication1, dans laquelle lesdits éléments de réception et de couvercle (2, 3) sont munis d'une pluralité desdits moyens d'accouplement mutuel de saillies et d'évidements(9b,9a,23a,23b).

3. Unitéémettriceselonlarevendication2, dans laquelle les moyens successifs d'accouplement mutuel de saillies et d'évidements (9b, 9a, 23a,23b)sontdisposésenréseaux.

4. Unité émettrice selon l'une quelconque des revendications1à3, dans laquelle le moyen ou chaque moyen d'accouplement mutuel de saillie (9b, 23a) est adjacent dans sa partie la plus étroite à la partie de rebord (8a, 22a) de l'élément (2, 3) à partir de laquelle il s'étend, et s'élargit en direction de la partie de rebord (8a, 22a) de l'autre élément (3, 2) alors que le moyen ou chaque moyen d'accouplement mutuel d'évidement (9a, 23b) est adjacent dans sa partie la plus large à la partie de rebord (8a, 22a) de l'élément (2, 3) dans laquelle il est constitué, et se rétrécit en direction de la partie de rebord (8a, 22a) del'autreélément(3,2)

5. Unitéémettriceselonlarevendication4, dans laquelle un moyen d'accouplement mutuel résilient évidé de saillie (9b, 23a) est constitué de manière à être adjacent à chaque moyen d'accouplementmutueld'évidement(9a,23b).

6. Unitéémettriceselonlarevendication3, dans laquelle ledit moyen d'accouplement mutuel de saillie (9b, 23a) et le moyen d'accouplement mutuel d'évidement (9a, 23b) correspondant sont sensiblementenformedequeued'aronde.

7. Unité émettrice selon l'une quelconque des revendications1à6, dans laquelle on constitue dans ledit boîtier (1) un évidement (24a) comportant une sortie d'évidement (26) formée dans une base de l'évidement, ledit évidemment (24a) comportant une entrée d'évidement ayant une surface sensiblement supérieure à la surface de ladite sortie d'évidement (26) et étant de plus grandes dimensions par comparaison avec la largeur de la voie d'écoulement (24c) entre l'entrée de l'évidement et la sortie de l'évidement ; une première surface de la membrane (4) adaptée à être exposée à ladite pression d'entrée du fluide ; une deuxième surface, opposée, de ladite membrane étant juxtaposée auxdites portions de rebord (22a, 22b) de manière à être appuyée contre lesdites parties de rebord sous ladite pression d'entrée et de manière à définir avec ledit évidement (24a) une chambre de commande de sortie ; la disposition étant telle que si ladite pression d'entrée du fluide dépasse la pression de fluide dans ladite chambre de commande de sortie d'une valeur prédéterminée, la membrane (4) se déforme en direction en direction de ladite sortie de l'évidement (26) de manière à définir avec la sortie de l'évidement une voie limitéed'écoulementdesortie.

8. Unité émettrice selon l'une quelconque des revendications1à7, dans laquelle on ménage dans une surface intérieure d'au moins l'un desdits éléments (2, 3) une rainure longitudinale (11, 24) qui, associée à la membrane (4), définit ladite voie limitée d'écoulement de sortie(11c,24c).

9. Unitéémettriceselonlarevendications8, dans laquelle on ménage dans les surfaces intérieures desdits deux éléments (2, 3) des rainures longitudinales (11, 24) qui, associées à ladite membrane (4), définissent respectivement lesdites voies limitées composantes d'écoulement (11c, 24c) qui communiquent avec un orifice de communication (28)pratiquédansladitemembrane(4).

10. Unitéémettriceselonlarevendication8ou9, dans laquelle chaque rainure (11, 24) est constituée par une paire de réseaux de chicanes (25) de limitationd'écoulementorientésdefaçonopposée.

11. Unité émettrice selon la revendication 9 ou 10 ajouteéàlarevendication7, dans laquelle ladite entrée (11a) de voie d'écoulement est associée à une première (11) desdites rainures (11, 24), ladite sortie de voie d'écoulement est associée à une deuxième (24) desdites rainures (11, 24), ladite entrée (13) de boîtier est constituée dans un premier (2) desdits éléments (2, 3), ladite sortie (26) de boîtier et ledit évidement (24a) sont constitués dans un deuxième (3) desdits éléments (2, 3), et ledit orifice de communication (28) est constitué dans ladite membrane (4) de manière ad-

jacente à une extrémité aval de ladite première rainure (11) et à une extrémité amont de ladite deuxièmerainure(24).

12. Unité émettrice selon l'une quelconque des revendications1à11,
dans laquelle ladite entrée de boîtier comprend un puits d'entrée (13) faisant saillie dans ledit boîtier (1) et comportant un rebord périphérique (16) de puits contre lequel on incline normalement de façon étanche ladite membrane (4), la disposition étant telle qu'une pression d'entrée de fluide minimale prédéterminée appliquée à ladite membrane (4) permet de déplacer la membrane à partir de sa position d'accouplement étanche avec le rebord (16) depuits.

13. Unité émettrice selon l'une quelconque des revendications1à12,
dans laquelle on constitue, adjacent à au moins un bord longitudinal de l'un desdits éléments (2) dans une surface extérieure de celui-ci, un canal longitudinal (17a, 17b) d'écoulement d'entrée, communiquant avec ladite entrée (13) de boîtier, adapté à être exposé vers l'intérieur du conduit (30) et comportant une pluralité de chicanes (18a, 18b) de filtrageplacéesselonlalongueurdecelui-ci.

14. Unitéémettriceselonlarevendication13,
dans laquelle lesdits deux canaux longitudinaux (17a, 17b) d'écoulement d'entrée sont respectivement constitués de manière adjacente aux bords longitudinauxopposésduditunélément(2).

15. Unitéémettriceselonlarevendication13ou14,
dans laquelle le ou chaque canal longitudinal (17a, 17b) d'écoulement d'entrée est constitué dans la surfaceextérieuredel'élémentderéception(2).

16. Unité émettrice selon la revendication 13, 14 ou 15,
dans laquelle lesdits canaux longitudinaux (17a, 17b) d'écoulement d'entrée débouchent tous dans laditeentrée(13)deboîtier.

17. Unité émettrice selon l'une quelconque des revendications13à16,
dans laquelle lesdits canaux longitudinaux (17a, 17b) d'écoulement d'entrée sont partiellement recouverts.

18. Système d'irrigation goutte à goutte comprenant un conduit d'irrigation (30) et une succession d'unités émettrices (1) espacées les unes des autres, conformes à l'une quelconque des revendications précédentes, collées sur une surface intérieure dudit conduit (30) aux parties de rebord d'accouplement mutueldesditséléments(2,3).

19. Unitéémettriceselonlarevendication1,
dans laquelle ladite membrane (4) est montée dans ledit boîtier (1) de manière à recouvrir et à s'accoupler mutuellement avec au moins une partie de laditevoied'écoulement(11c,24c).

20. Unitéémettriceselonlarevendication19,
dans laquelle ladite entrée de boîtier comprend un puits (13) d'entrée faisant saillie dans ledit boîtier et comportant un rebord périphérique (16) de puits aveclequelladitemembrane(4)estjuxtaposée.

21. Unitéémettriceselonlarevendication20,
dans laquelle on incline normalement ladite membrane (4) de façon étanche contre le rebord périphérique (16) de puits, la disposition étant telle qu'une pression d'entrée de fluide minimale prédéterminée appliquée à ladite membrane permet de déplacer la membrane à partir de sa position d'accouplementétancheaveclereborddepuits.

22. Unitéémettriceselonlarevendication1,
dans laquelle ladite membrane (4) est adaptée à limiterl'écoulementdesortie.

23. Unitéémettriceselonlarevendication1,
dans laquelle lesdites parois (84', 84") sont en interactionquandonassembleleditboîtier(1).

24. Unitéémettriceselonlarevendication1,
dans laquelle lesdites parois (84', 84") sont orientées transversalement par rapport aux axes longitudinaux quand on les regarde dans une direction d'assemblagedesditséléments(2,3).

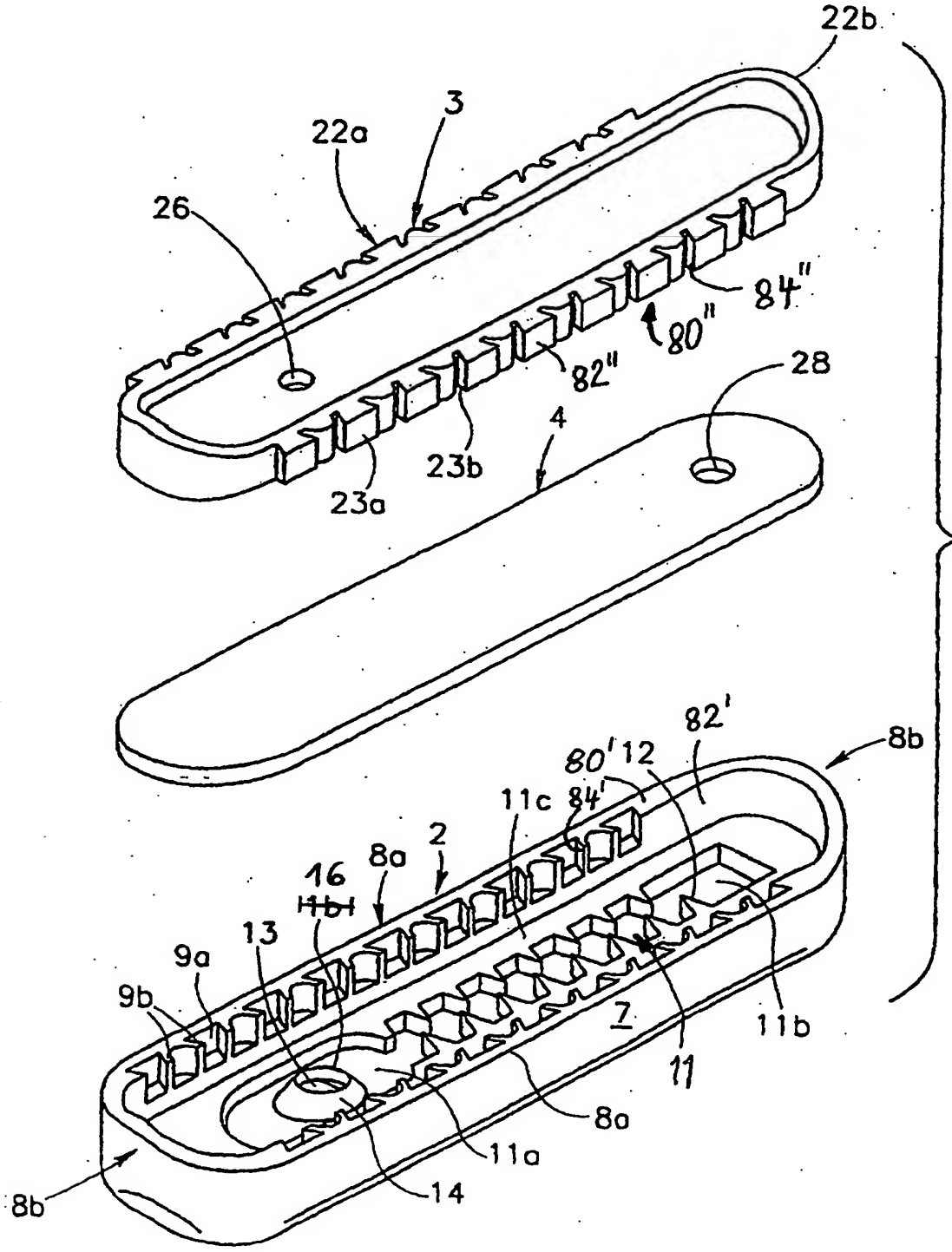
22b
3
22a
26
84"
80"
82"
28
4
23b
23a
82'
8b
80'
12
11c
84'
2
8a
16
13
9a
9b
7
11b
11
8a
11a
14
8b

FIG. 1

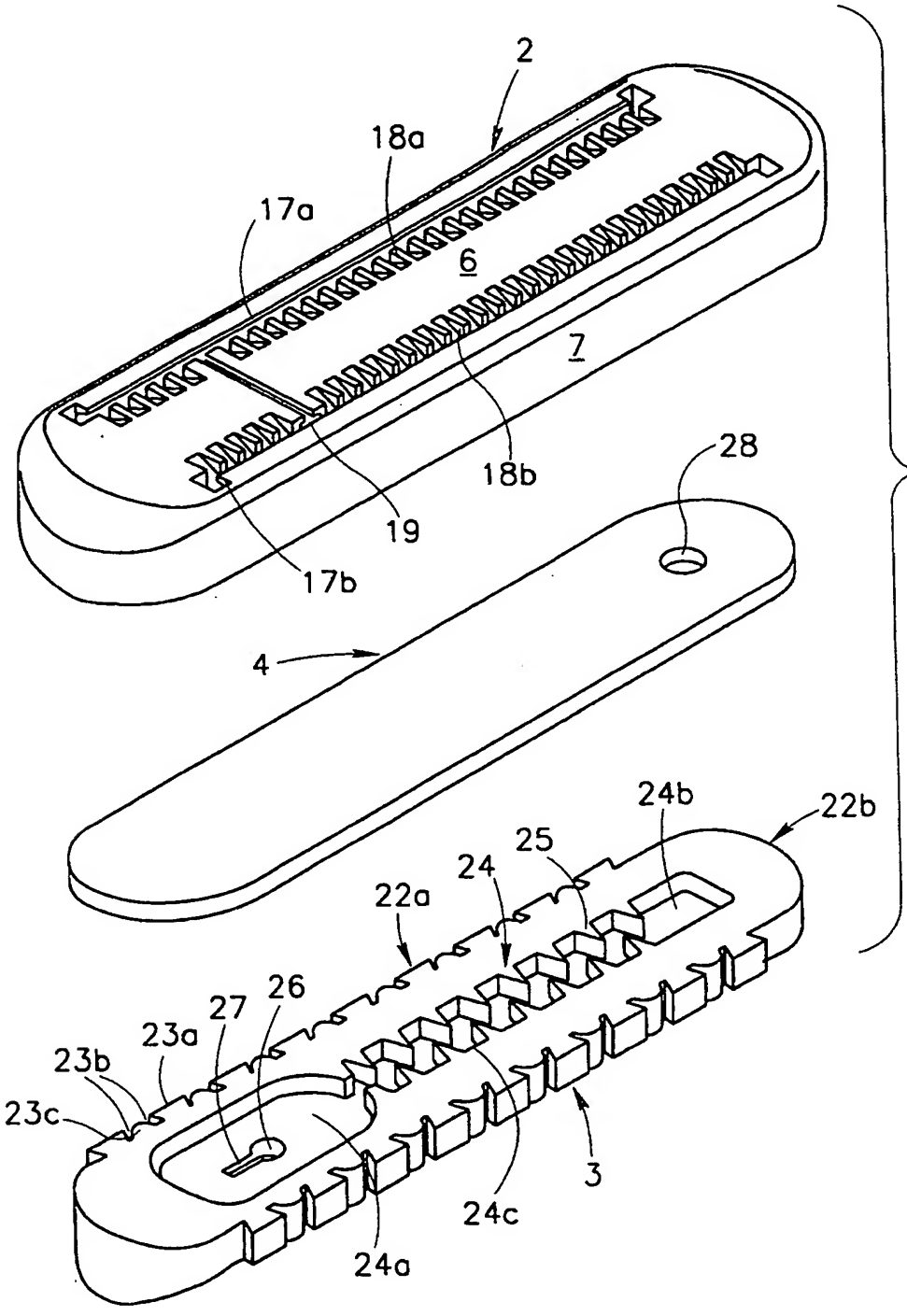
2
18a
17a
6
7
18b
19
17b
28
4
24b
22b
25
24
22a
27
26
23a
23b
23c
3
24c
24a

FIG.2

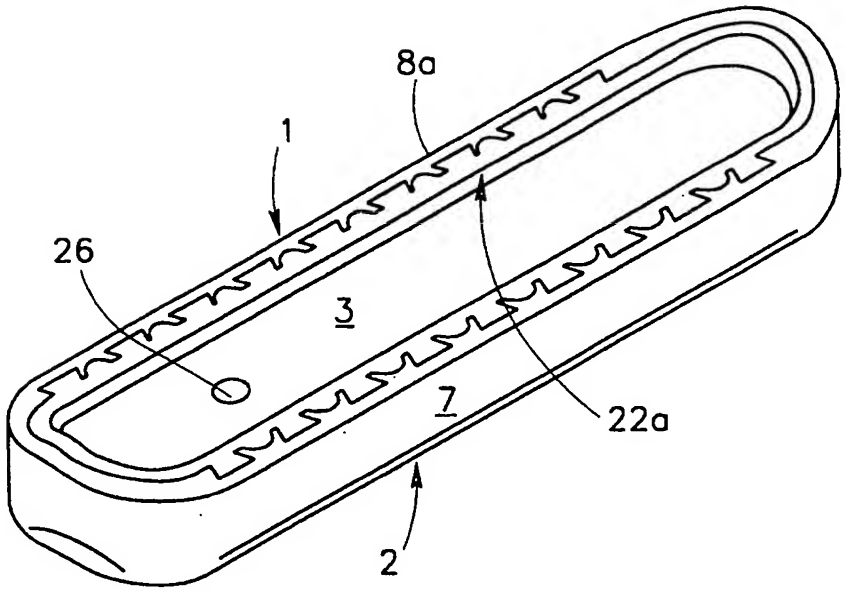

FIG.3

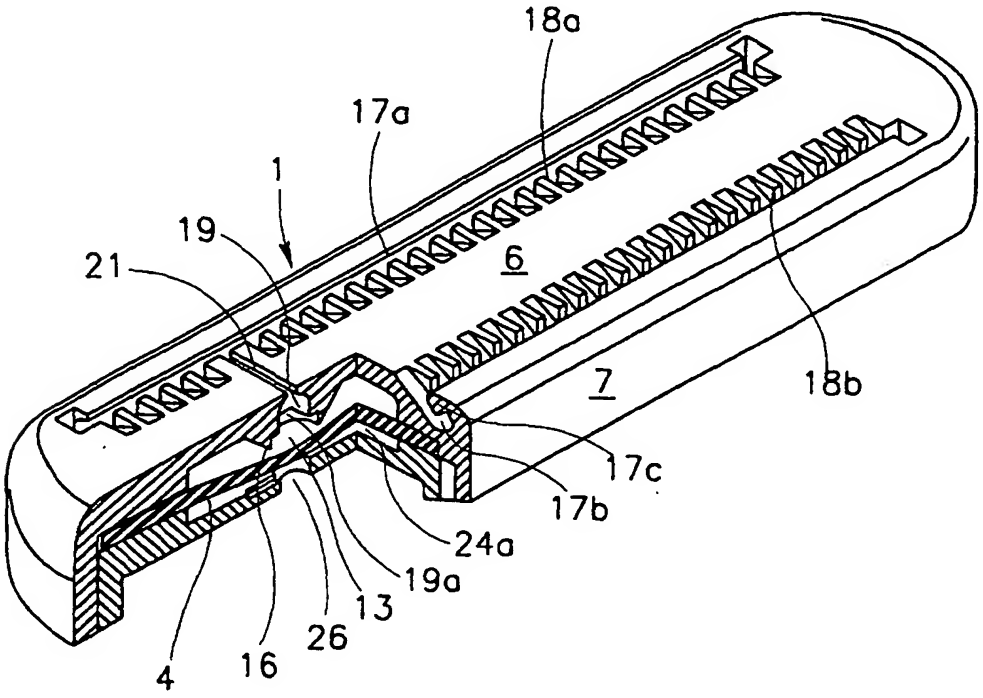

FIG.4

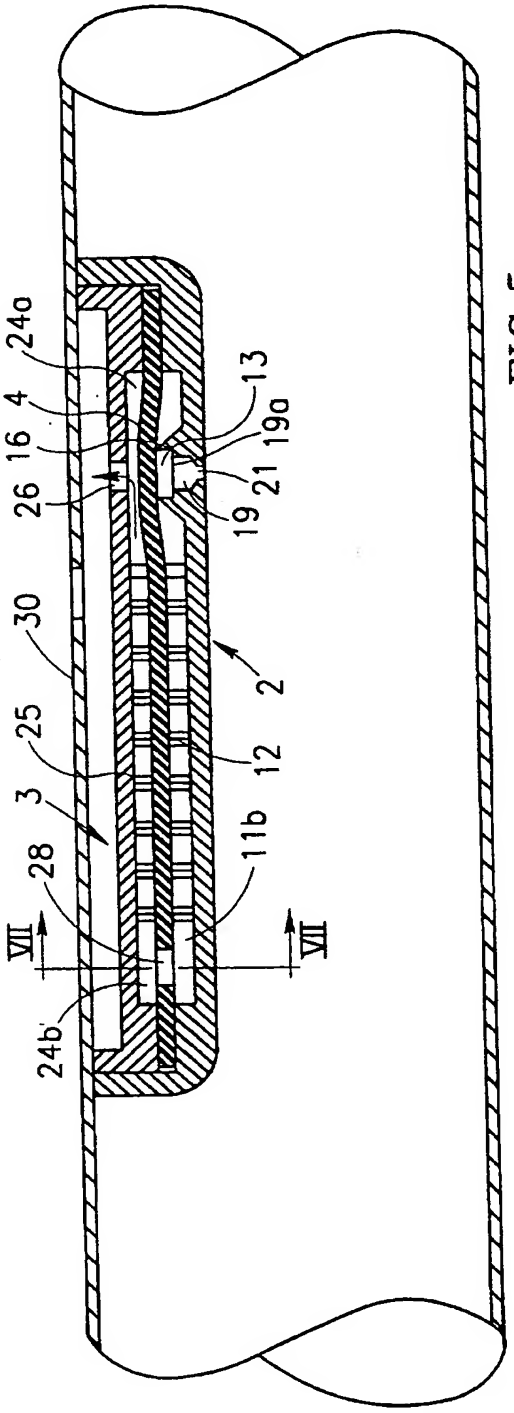
24a
4
16
26
30
25
3
28
VII
24b
13
19a
21
19
2
12
11b
VII

FIG.5

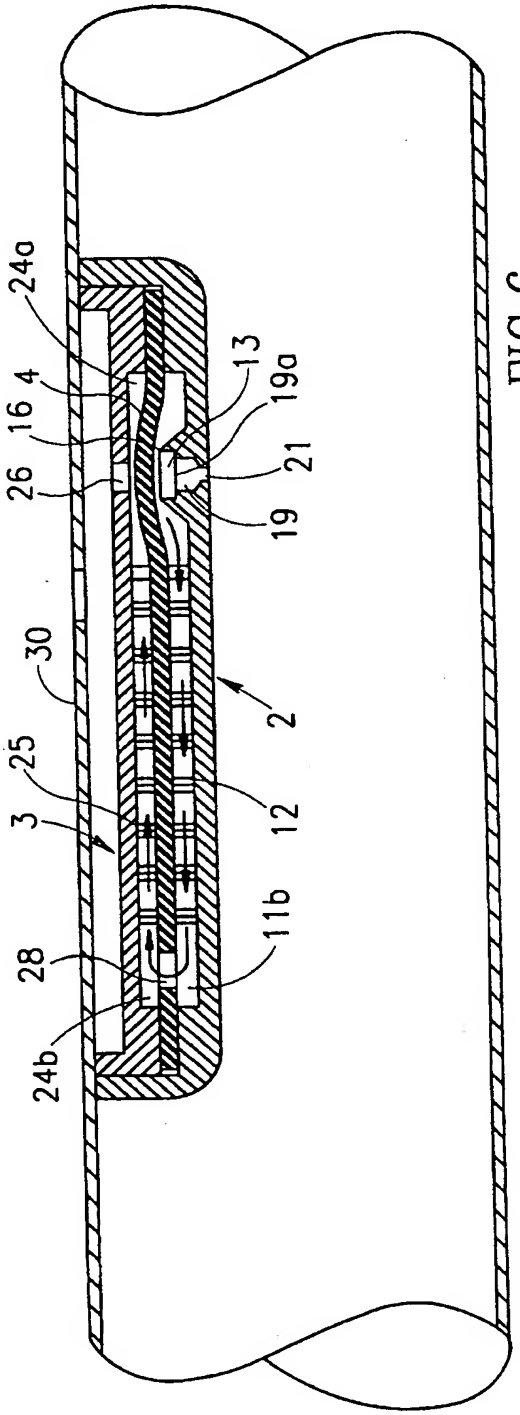
24a
4
16
26
30
25
3
28
24b
13
19a
21
19
2
12
11b

FIG.6

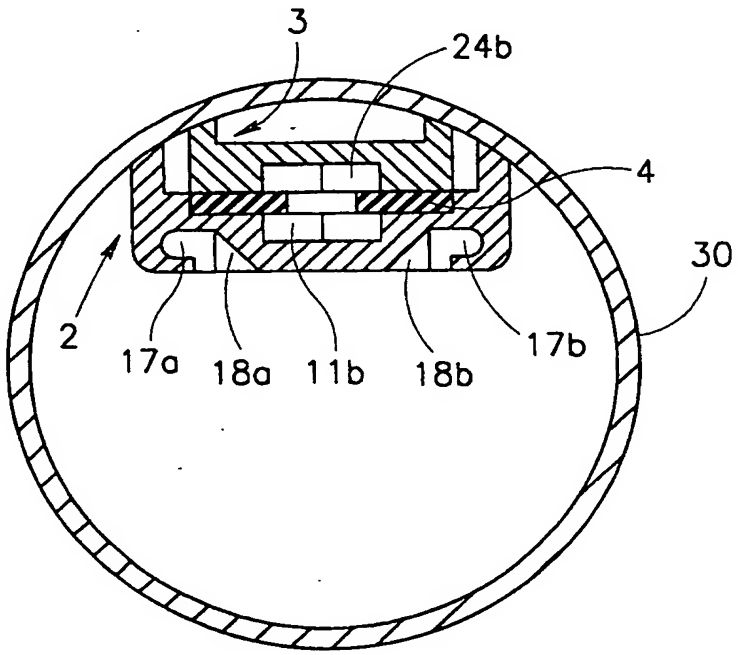

FIG.7